Small Business Innovation Research/Small Business Tech Transfer

Model-Based Design Assessment and FM Visualization Technologies in TEAMS, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

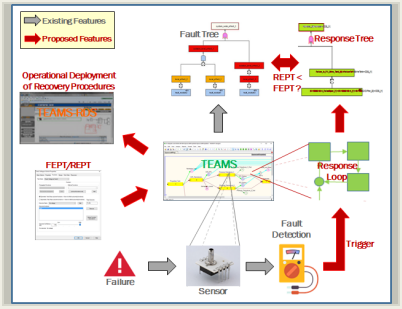
NASA's FM community has identified one of the major problems with FM on the Science Mission Directorate (SMD) missions being that the complexity of FM has often been discovered late in the system development during testing, or in other cases in flight itself requiring unplanned, major spikes in resources to ensure that it will work properly and not create failures in the system that it is trying to protect. Some FM issues show up during the mission, which have led to a range of outcomes from near to actual losses of science data and near-losses and actual losses of spacecraft. Addressing these issues requires much better understanding of a system's FM design and the relationship of the design to the resulting system behaviors. A first step in achieving that improved understanding at reasonable cost is the Modeling and Visualization of the FM architecture for system designers and operators. The work proposed here aims to enable FM architectural Modeling and Visualization. Architectural models are a critical step for future work to implement FM metrics across the entire FM architecture, from state estimation through control of system states and behaviors. This modeling and visualization significantly enhances the ability to qualitatively and quantitatively understand a system's FM design, which in turn enables more effective trade studies of different design and operational options that better grasp FM completeness and complexity.

Qualtech Systems, Inc. (QSI), in collaboration with Dr. Stephen B. Johnson, President of Dependable System Technologies, LLC (DST), plan to develop techniques and the concomitant software modules for enabling FM Visualization and Design Assessment in QSI's TEAMS® (Testability Engineering And Maintenance System) Toolset to address FM metrics for failure response/recovery, and will be linked to ongoing efforts to implement FM Metrics and to overall system autonomy, but targeting SMD science missions and their unique goals.

Anticipated Benefits

The proposed technology will allow NASA to better plan and execute future Science Missions. It can also readily operate as part of NASA's next generation Mission Control Technology, allowing NASA to utilize the fault management and mission satisfiability information for improved mission execution while improving safety and mission success probability. NASA's upcoming ARCUS X-ray Observatory is an appropriate candidate system to model the FM Visualization and Design Assessment capabilities.

DoD, US Air Force, US Navy, Commercial Aviation, large scale military systems such as NORAD, Space Command ground segments, JSF fleet, Navy shipboard platforms, Submarine Commands and BMD systems, UAVs, UMGs and other unmanned submersible vehicle markets, manufacturers of DoD and Military's remotely guided weapons and reconnaissance systems, OEM customers of high-value high-assurance equipment, such as semiconductor manufacturing and medical diagnostic equipment, are potential applications.



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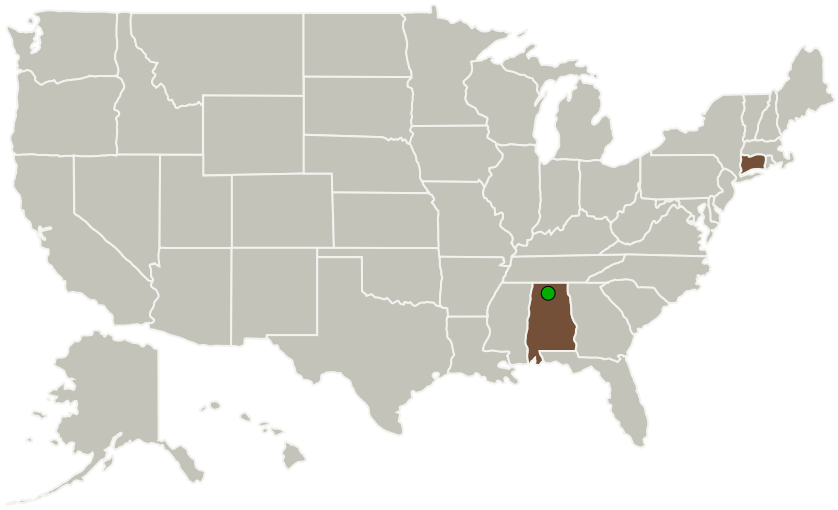
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Qualtech Systems, Inc.	Lead Organization	Industry Minority-Owned Business, Small Disadvantaged Business (SDB)	Rocky Hill, Connecticut
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Connecticut

Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Qualtech Systems, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Deepak Haste

Co-Investigator:

Deepak Haste

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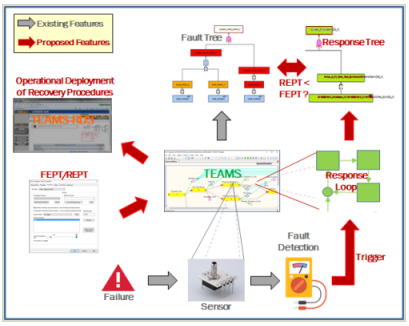
February 2019: Closed out

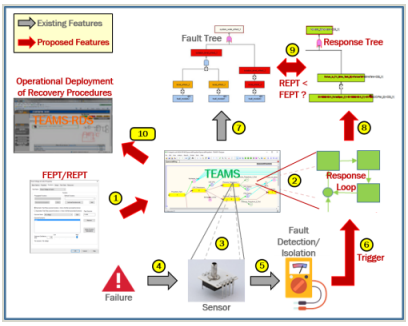
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141176)*

Images



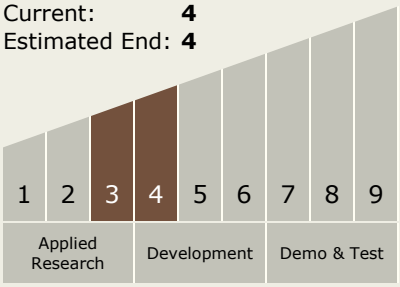
Briefing Chart Image
Model-Based Design Assessment and FM Visualization Technologies in TEAMS, Phase I *(https://techport.nasa.gov/image/134669)*



Final Summary Chart Image
Model-Based Design Assessment and FM Visualization Technologies in TEAMS, Phase I *(https://techport.nasa.gov/image/126692)*

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - TX02.2 Avionics Systems and Subsystems
    - TX02.2.1 Spacecraft Command and Data Handling Systems (C&DH)

Target Destinations

Foundational Knowledge, Others Inside the Solar System